ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 612293

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [X] (JB); Direct Revision [X]; Change ECN []; Temporary []; Standby []; Supersedure []; Cancel/Void []	J. G. Field, LMHC, R2-12	[] Yes [X] No	7/17/97
	6. Project Title/No./Work Order No.: Tank 241-A-102	7. Bldg./Sys./Fac. No.: NA	8. Approval Designator: NA
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.): WHC-SD-WM-ER-597, Rev. 0	10. Related ECN No(s).: NA	11. Related PO No.: NA

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	NA	NA Design Authority/Cog. Engineer Signature & Date	NA Design Authority/Cog. Engineer Signature & Date

13a. Description of Change — 13b. Design Baseline Document? [] Yes [X] No

Add Appendix C, Evaluation to Establish Best-Basis Inventory for Single-Shell Tank 241-A-102.

14a. Justification (mark one)

Criteria Change	[]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[X]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-A-102 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

15. Distribution (include name, MSIN, and no. of copies)

Central Files	A3-88	K. M. Hall	R2-12
DOE Reading Room	H2-53	K. M. Hodgson	R2-11
TCSRC	R1-10	J. Jo	R2-12
File	H5-49	B. A. Higley	H5-27
J. G. Field	R2-12		
M. J. Kupfer	H5-49		
M. D. LeClair (3)	H0-50		

RELEASE STAMP

AUG 25 1997
DATE:
STA: 37
HANFORD RELEASE
ID: 20

A-7900-013-2 (05/96) GEF095

A-7900-013-1 (06/92)

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 612293

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
NA		

21. Approvals

	Signature	Date		Signature	Date
Design Authority		7-22-97	Design Agent		
Cog. Eng. M. J. Kupfer		7-23-97	PE		
Cog. Mgr. K. M. Hodgson	K. M. Hodgson		QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other J. Jo	JJ	7-24-97	Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

Tank Characterization Report for Single-Shell Tank 241-A-102

B. A. Higley and J. G. Field
Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 612293 UC: 712
Org Code: 74610 Charge Code: N4G3A
B&R Code: EW3120074 Total Pages: 116

Key Words: TCR, best-basis inventory

Abstract: An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities. As part of this effort, an evaluation of available information for single-shell tank 241-A-102 was performed, and a best-basis inventory was established. This work follows the methodology that was established by the standard inventory task.

Printed in the United States of America. To obtain copies of this document, contact: Document Control Services, P.O. Box 950, Mailstop H6-08, Richland WA 99352, Phone (509) 372-2420; Fax (509) 376-4989.

AUG 25 1997
DATE:
STA: 37
HANFORD RELEASE
ID: 20

Janis Bishop 8/25/97
Release Approval Date

Release Stamp

Approved for Public Release

RECORD OF REVISION	(1) Document Number WHC-SD-WM-ER-597	Page 1

(2) Title
Tank Characterization Report for Single-Shell Tank 241-A-102

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 7/29/96 on EDT 617507.	J. Jo	J. G. Kristofzski
0A RS	Incorporate per ECN-612293.	M. J. Kupfer	K. M. Hodgson
		M. J. Kupfer 7-22-97	K. M. Hodgson 7-23-97

A-7320-005 (08/91) WEF168

APPENDIX C

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-A-102

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APPENDIX C

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-A-102

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for single-shell tank 241-A-102 was performed, and a best-basis inventory estimate for chemical and radionuclide components was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

C1.0 CHEMICAL INFORMATION SOURCES

Appendix A provides characterization results from the 1996 characterization event for tank 241-A-102. Two auger samples were obtained, one of which was analyzed for chemicals. A sample-based inventory is reported in Section 3.0 based on the auger sample analytical results, a waste density of 1.70 g/mL, and a waste volume of 155 kL. Appendix B also provides analytical results from the 1986 core sampling event. The Hanford Defined Waste (HDW) model (Agnew et al. 1996) provides tank contents estimates, derived from process flowsheets and waste volume records.

C2.0 COMPARISON OF COMPONENT INVENTORY VALUES

The sample-based inventory estimate from Section 3.0 and the inventory estimate from the HDW model (Agnew et al. 1996) for tank 241-A-102 are shown in Table C2-1 and C2-2. The waste volume used to generate the estimate is 155 kL. The estimates, however use different waste densities. The sample-based inventory uses a measured bulk density of 1.7 g/mL. The current HDW model uses a waste density of 1.26 g/mL. Many significant differences between the sample-based and HDW model inventories are apparent. Estimates obtained from the two methods for Al, Bi, Cl, Cr, Fe, Mn, Na, Ni, NO_2, oxalate, Pb, PO_4, Si, Sr, CO_3, U, and Zr vary by a factor of two or more. (The chemical species are reported without charge designation per the best-basis inventory convention.)

Table C2-1. Sampling and Hanford Defined Waste Model-Based Inventory Estimates for Nonradioactive Components in Tank 241-A-102.

Analyte	Sampling inventory estimate[a] (kg)	HDW model inventory estimate[b] (kg)	Analyte	Sampling inventory estimate[a] (kg)	HDW model inventory estimate[b] (kg)
Al	8,350	2,600	Ni	109	16.9
Bi	88.5	14.7	NO_2	21,900	6,730
Ca	182	126	NO_3	23,800	15,900
Cl	2,100	448	OH	NR	9,200
Cr	2,320	146	Pb	372	16.3
F	<73	81.2	P as PO_4	1,290	512
Fe	5,170	971	Si	1,030	697
FeCN/CN	8.1	0	S as SO_4	1,180	1,680
Hg	NR	0.115	Sr	8.3	0.0369
K	812	136	TIC as CO_3	5,710	2,040
La	27.1	0.175	Ti	9.00	NR
Mn	891	14.8	TOC	3,910	1,923
Na	34,000	17,200	U_{TOTAL}	9,300	2,850
Nd	60.7	NR	Zr	128	3.37
NH_4	NR	64.5	H_2O(Wt%)	34.3	66.3
Density (kg/L)	1.7	1.26			

HDW = Hanford Defined Waste
NR = Not reported
[a]Appendix B
[b]Agnew et al. 1996.

Table C2-2. Sampling and Hanford Defined Waste Model-Based Inventory Estimates for Radioactive Components in Tank 241-A-102.

Analyte	Sampling inventory estimate[a] (Ci)	HDW model inventory estimate[b, c] (Ci)
^{137}Cs	NR	16,300
^{90}Sr	NR	100,000
$^{239/240}Pu$	NR	49
Total α	1,230	NR

HDW = Hanford Defined Waste
NR = Not reported
[a]Appendix B (1996 auger sample)
[b]Agnew et al. (1996)
[c]Decayed to January 1, 1994.

C3.0 COMPONENT INVENTORY EVALUATION

The following evaluation of tank contents is performed in order to identify potential errors and/or missing information that would influence the sampling-based and HDW model component inventories.

C3.1 CONTRIBUTING WASTE TYPES

Tank 241-A-102 was put in service in March 1956. From 1956 to 1963 the tank receipts included PUREX HLW and organic wash waste. The tank began self boiling in 1958. In 1964 tank 241-A-102 was the sludge accumulation tank and liquid feed tank for the sluicing process test in tank 241-A-103. From 1963 to 1972 tank farm records indicate many transfers both in and out of 241-A-102. Tank 241-A-102 was sluiced in 1972, 1973, and in 1974 in support of strontium recovery at B Plant. Sludge was removed to a 2.54- 5.08-cm (1- to 2-in.) heel to allow salt cake storage (Rodenhizer 1987, Anderson 1990, Agnew et al. 1995).

After sluicing, tank 241-A-102 received strontium recovery waste from B Plant. The tank was sluiced again in 1976 to tank 241-A-106 leaving a 4-8 kL heel (Rodenhizer 1987).

Starting in the fourth quarter of 1976, tank 241-A-102 became the primary feed tank for the 242-A Evaporator Crystallizer. As the 242-A Evaporator Crystallizer feed tank, tank

241-A-102 was in near continuous use from 1976 to 1980, staging various supernatants for concentration. During this time period solids from various evaporator products accumulated in tank 241-A-102, including Evaporator Feed (EVAP), Non-complexed waste (NCPLX), Complexed waste (CPLX), and Double-Shell Slurry Feed (DSSF). Supernatant was pumped from the tank to 241-AN-101 in 1989.

The current waste volumes for tank 241-A-102 are shown in Table C3-1 (Hanlon 1996).

Table C3-1. Waste Inventory of Tank 241-A-102 (Hanlon 1996).

Waste	Volume (kL)	Volume (kgal)
Sludge	57	15
Saltcake	83	22
Supernatant	15	4
Drainable Interstitial Liquid	7.6	2
Total Waste	155	41

The types of solids accumulated in tank 241-A-102 reported by various authors is compiled in Table C3-2 and Table C3-3. Waste types in brackets are expected to have been removed when the tank was sluiced in 1976.

Table C3-2. Expected Solids for Tank 241-A-102.

Reference	Waste type[a]
Anderson (1990)	[P, OWW, B, PSS], EVAP, DSSF, NCPLX, CPLX
SORWT Model (Hill et al. 1995)	DSSF, NCPLX, EVAP
WSTRS (Agnew et al. 1995)	[SU, OWW, P, PSS], SRR, SU, EVAP, NCPLX, CPLX, DSSF
HDW Model (Agnew et al. 1996)	SRR, SMMA1, SMMA2

B = B Plant Waste
CPLX = Complexed Waste
DSSF = Double Shell Slurry Feed
EVAP = Evaporator Feed
NCPLX = Non-Complexed Waste
OWW = Organic Wash Waste
P = PUREX HLW
PSS = PUREX Sludge Supernatant
SMMA1 = Supernatant Mixing Model A Evaporator 1
SMMA2 = Supernatant Mixing Model A Evaporator 2
SRR = Strontium Recovery Waste
SU = Supernatant
WSTRS = Waste Status and Transaction Record Summary
[a]Waste types in brackets are expected to have been removed when the tank was sluiced in 1976.

Table C3-3. Hanford Defined Waste Model[a] Solids for Tank 241-A-102.

HDW solids layer	kL	kgal
SRR	11	3
SMMA1	72	19
SMMA2	57	15

HDW = Hanford Defined Waste
SMMA1 = Supernatant Mixing Model A Evaporator 1
SMMA2 = Supernatant Mixing Model A Evaporator 2
SRR = Strontium Recovery Waste
[a]Agnew et al. (1996).

C3.2 EVALUATION OF PROCESS FLOWSHEET INFORMATION

Tank 241-A-102 appears to contain little actual sludge and appears to contain several evaporator products including EVAP, NCPLX, CPLX, and DSSF.

Review of Anderson (1990) and Agnew et al. (1995) indicates the following chain of events probably occurred.

- Between startup in 1956 and sluicing in 1976, tank 241-A-102 was used to store various wastes generated by PUREX.

- Sluicing in 1972, 1973, and 1974 reduced the sludge in tank 241-A-102 to a 10-21 kL heel. This met the sludge heel requirement for tanks scheduled to be used for salt cake storage of a 2.54- to 5.08-cm (1- to 2-in.) sludge heel. The requirement was based on radiolytic heating temperature control limits (Rodenhizer 1987).

- 64 kL (17 kgal) of solids were accumulated in tank 241-A-102 in 1974-1975 from strontium recovery waste stored in tank.

- Sluicing in 1976 left a 4 to 8 kL solids heel in the tank (Anderson 1990).

- Between 1976 and 1980, tank 241-A-102 was used as the 242-A Evaporator Crystallizer feed and dump tank. As such, tank 241-A-102 could have accumulated solids due to; fines carried over with supernatants, precipitates from the mixing of supernatants, use as the evaporator dump tank, and cooling of hot product liquors returned to the feed tank for additional concentration.

- 23 kL of solids were accumulated in the tank by the end of 1977.

- Solids level determinations in 1978 were 30 kL in the first quarter, 64 kL in the second quarter, and 42 kL in the third quarter after the addition of non-complexed waste. The solids level was reported again as 64 kL in the forth quarter with DSSF being the latest addition.

- In 1979 both complexed and non-complexed supernatants were staged to the 242-A Evaporator Crystallizer from the tank. The solids level does not appear to have been remeasured and is reported as 64 kL.

- In 1980 DSSF and non-complexed waste were staged to the 242-A Evaporator Crystallizer from the tank. The solids level was redetermined at the end of the year as 83 kL.

- Supernatant was pumped from the tank in 1989 and the solids volume was determined to be 140 kL.

From these observations, several conclusions can be made. With respect to tank layers defined by the HDW model, it is doubtful that the bottom layer in the tank is 11 kL of SRR waste. It is more likely that the sludge heel contains both PUREX and SRR solids. There is also uncertainty as to the volume of this layer, Anderson (1990) reports 4 to 8 kL of solids.

The other HDW model layers, SMMA1 and SMMA2 correspond well with measurements of solids level made in 1980 and 1989 respectively. The process history of tank 241-A-102 supports the position that these layers are salt cake and DSSF rather than sludge and salt cake as reported by Hanlon (1996).

Interpretation from descriptions of the samples is mixed. The verbal description of the 1986 core samples describe the upper segments as being light colored and crystalline looking. The lower segments were dark brown and gritty (Weiss and Schull 1988). The auger sample was described (Section 5.1) as a runny brown wet sludge. The descriptions, however, do not include a discussion of layer height nor does it indicate if a full height sample was recovered.

Hanlon (1996) currently reports a sludge volume of 57 kL (15 kgal) for tank 241-A-102. The basis for this determination, made July 27, 1989, is not known. The previously reported sludge volume of 30 kL (8 kgal) corresponds to solids accumulated and reported as Evaporator Feed in tank farm records. What the 57 kL sludge volume reported by Hanlon likely represents is a determination of the solids accumulated under the DSSF. Based on the process history of this tank, and the sample-based inventory, it appears that this material may be more characteristic of salt cake rather than sludge. Perhaps the best description would be to consider this material a "dirty" saltcake. The sample-based inventory is suggestive of a small volume of sludge since the inventory of transition and group III and IV metals is a small contribution to the total inventory.

C3.3 INDEPENDENT EVALUATION OF TANK SAMPLE INFORMATION

Table C3-4 provides an estimate of the waste in tank 241-A-102 from sample data extracted from Appendix A and Appendix B. The waste inventory estimates are calculated using a waste volume 155 kL and the densities shown in the table. Although Hanlon (1996) reports that this volume includes 15 kL of supernatant, a correction for supernatant volume has not been made since a recent in-tank video shows that the surface is primarily dried and cracked. Small pools of supernatant remain, but the overall supernatant volume is probably less than Hanlon's estimate of 15 kL.

Table C3-5 shows data from two sampling events as well as the composite estimate. The 1996 sampling event is for an auger sample. Sample recovery appears to have been average to poor and only one riser was sampled. The 1986 sample is the average of two cores taken from one riser. The core sample analysis were not documented to current QC requirements, however there is no reason to believe that the samples were not analyzed using good laboratory practice. Sample recovery is stated at being 100 percent.

The auger sample was taken from a different riser than was the core sample. The differences in concentration obtained for several analytes suggest that spatial variability may be high in this tank. Thus a composite estimate for 241-A-102 was assembled using the average inventories from the 1986 and 1996 samples. Data from the 1996 auger sample were used exclusively when analytes were not available from the 1986 core sample.

Table C3-4. Inventory Estimate for Tank 241-A-102 Derived from the 1986 Core Sample and the 1996 Auger Sample. (2 Sheets)

Analyte	Tank 241-A-102 sampling data				Estimated inventory for 241-A-102
	1986 core sample		1996 auger sample		
	µg/g	kg	µg/g	kg	kg
Density (kg/L)	1.59		1.7		
Al	23,300	5,740	31,700	8,350	7,045
Bi	1,740	429	336	88.5	259
Ca	2,590	638	690	182	410
Cl	NR	NR	7,970	2,100	2,100
TIC as CO_3	NR	NR	21,680	5,710	5,710
Cr	5,800	1,430	8,800	2,320	1,880
F	NR	NR	<277	<73	<73
Fe	14,000	3,450	19,600	5,170	4,310
Hg	NR	NR	NR	NR	NR
K	2,820	695	3,080	812	754
La	NR	NR	103	27.1	27
Mn	2,150	530	3,380	891	710
Na	187,000	46,100	129,000	34,000	40,000
Ni	526	130	413	109	120
NO_3	179,000	44,100	90,300	23,800	34,000
NO_2	NR	NR	83,200	21,900	21,900
Pb	1,180	291	1,410	372	332
P as PO_4	16,067	3,960	4,906	1,290	2,630
Si	16,600	4,090	3,920	1,030	2,560
S as SO_4	NR	NR	4,480	1,180	1,180
Sr	97.6	24	31.5	8.3	16
TOC	7,570	1,870	14,850	3,910	2,890
U_{TOTAL}	9,540	2,350	35,300	9,300	5,830
Zr	1,440	355	484	128	241

Table C3-4. Inventory Estimate for Tank 241-A-102 Derived from the 1986 Core Sample and the 1996 Auger Sample. (2 Sheets)

Analyte	Tank 241-A-102 sampling data				Estimated inventory for 241-A-102
	1986 core sample		1996 auger sample		
	$\mu g/g$	kg	$\mu g/g$	kg	kg
H_2O (wt%)	NR	NR	34.3		

NR = Not reported.

Table C3-5 shows the sample-based inventory estimate derived from the 1996 auger sampling event, the estimated inventory derived by the independent evaluation, and the HDW model based estimate.

Table C3-5. Comparison of Inventory Estimates for Tank 241-A-102 Derived From the 1996 Auger Sampling Event, by the Independent Evaluation, and by the Hanford Defined Waste Model. (2 Sheets)

Analyte	1996 auger-sample derived inventory estimate	Independent evaluation derived inventory estimate (1986 and 1996 samples)	HDW model derived inventory estimate (Agnew et al. 1996)
	(kg)	(kg)	(kg)
Al	8,350	7,045	2,600
Bi	88.5	259	14.7
Ca	182	410	126
Cl	2,100	2,100	448
TIC as CO_3	5,710	5,710	2,040
Cr	2,320	1,880	146
F	<73	<73	81.2
Fe	5,170	4,310	971
Hg	NR	NR	0.115
K	812	754	136
La	27	27	0.175
Mn	891	710	14.8
Na	34,000	40,000	17,200

Table C3-5. Comparison of Inventory Estimates for Tank 241-A-102 Derived From the 1996 Auger Sampling Event, by the Independent Evaluation, and by the Hanford Defined Waste Model. (2 Sheets)

Analyte	1996 auger-sample derived inventory estimate	Independent evaluation derived inventory estimate (1986 and 1996 samples)	HDW model derived inventory estimate (Agnew et al. 1996)
	(kg)	(kg)	(kg)
Ni	109	120	16.9
NO_3	23,800	34,000	15,900
NO_2	21,900	21,900	6,730
OH	30,480[a]	25,110[a]	9,200
Pb	372	332	16.3
P as PO_4	1,290	2,630	512
Si	1,030	2,560	697
S as SO_4	1,180	1,180	1,680
Sr	8.3	16	0.0369
TOC	3,910	2,890	1,923
U_{TOTAL}	9,300	5,830	2,850
Zr	128	241	3.37

HDW = Hanford Defined Waste
NR = Not reported.
[a]Derived based on a mass balance of the sample results. Attributes all of the unaccounted for negative charge to OH.

The existing photo montage for tank 241-A-102 was taken prior to supernatant removal and does not represent current conditions in the tank. A February 1996 in-tank video shows the surface to be dried and cracked with intermittent pools of liquid.

C3.3 DOCUMENT ELEMENT BASIS

This section compares two sample-based estimates to the inventory estimate calculated by the HDW model.

Aluminum. The estimate derived from the 1996 auger sample, versus the independent evaluation of both the 1986 core sample and 1996 auger sample, and the HDW model estimate for aluminum are 8,350 kg, 7,045 kg, and 2,600 kg respectively. Using the 1986 core sample data in conjunction with 1996 auger sample data lowers the aluminum inventory by only 16 percent from the auger sample only based estimate. The reason for the low aluminum value reported by the HDW model is not known but appears to be a function of the supernatant mixing models.

Bismuth. The estimate derived from the 1996 auger sample, versus the independent evaluation of both the 1986 core sample and 1996 auger sample, and the HDW model estimate for bismuth are 88.6 kg, 259 kg, and 14.7 kg respectively. Inclusion of the 1986 core sample data nearly triples the value of the previous estimate for bismuth in this tank. The most logical explanation for this difference is that the 1986 core sample accessed a pocket or layer of sludge that did not exist or was not accessed at the auger sampling site. The bismuth found in tank 241-A-102 cannot be attributed directly to any waste type known to be added to the tank. However, the concentration is relatively small in all cases and thus could be the result of an indirect addition or an undocumented transfer.

Calcium. The estimate derived from the 1996 auger sample, versus the independent evaluation of both the 1986 core sample and 1996 auger sample, and the HDW model estimate for calcium are 182 kg, 410 kg, and 126 kg respectively. The calcium inventory for this tank is essentially doubled by inclusion of the 1986 core sampling data. The calcium inventory for this tank is still a minor contributor to the global calcium inventory, less than 0.2 percent of the total calcium inventory.

Iron. The estimate derived from the 1996 auger sample, versus the independent evaluation of both the 1986 core sample and 1996 auger sample, and the HDW model estimate for calcium are 5,170 kg, 4,310 kg, and 971 kg respectively. The estimates for the two sample based estimates are within 20 percent of each other and are not considered to be significantly different. The reason for the low HDW model estimate is not know but may be an indication that iron as fines was carried into the tank at some time during supernatant transfers into the tank.

Manganese. The estimate derived from the 1996 auger sample, versus the independent evaluation of both the 1986 core sample and 1996 auger sample, and the HDW model estimate for manganese are 892 kg, 710 kg, and 14.8 kg respectively. The estimates for the two sample based estimates are within 20 percent of each other and are not considered to be significantly different. The low manganese inventory determined by the HDW model appears to be a source term error of the model.

Silicon. The estimate derived from the 1996 auger sample, versus the independent evaluation of both the 1986 core sample and 1996 auger sample, and the HDW model estimate for silicon are 1,030 kg, 2,560 kg, and 697 kg respectively. Inclusion of the 1986 core sample data increased the value of the previous estimate for silicon by about 40 percent for this tank. The value determined by the HDW model is 27 to 40 percent of the values determined from core sampling data. Low silicon inventory estimates appear to be a source term error of the HDW model.

Sulfate. The estimate derived from the 1996 auger sample, and the HDW model estimate for sulfate are 1,180 kg, and 1,680 kg respectively. The 1986 core sample did not include a sulfate analysis.

Total Hydroxide. Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. In some cases, this approach requires that other analyte (e.g., sodium or nitrate) inventories be adjusted to achieve the charge balance. During such adjustments, the number of significant figures is not increased. This charge balance approach is consistent with that used by Agnew et al. (1996). The revised total hydroxide inventory based on sample analyses is 25,110 kg, which is 170% more than the HDW model estimate. Most of this difference results from the fact that the sodium inventory calculated from sample analyses is approximately two times higher than the HDW model prediction.

Phosphate. The estimate derived from the 1996 auger sample, versus the independent evaluation of both the 1986 core sample and 1996 auger sample, and the HDW model estimate for phosphate are 1,660 kg, 2,630 kg, and 512 kg respectively. Inclusion of the 1986 core sample data increased the value of the previous estimate for phosphate by about 60 percent for this tank. The value determined by the HDW model is 20 to 30 percent of the values determined from core sampling data. The technical basis for the low phosphate inventory estimate by the HDW model has not been identified, but a combination of source term errors and inaccurate solubility assumptions about phosphate are suspected.

Total Inorganic Carbon. The estimate derived from the 1996 auger sample, and the HDW model estimate for total inorganic carbon are 5,710 kg, and 2,040 kg respectively. The 1986 core sample did not include a total inorganic carbon analysis.

Uranium. The estimate derived from the 1996 auger sample, versus the independent evaluation of both the 1986 core sample and 1996 auger sample, and the HDW model estimate for uranium are 9,310 kg, 5,830 kg, and 2,850 kg respectively. Inclusion of the 1986 core sample data decreased the value of the previous estimate for uranium by about 40 percent for this tank. The value determined by the HDW model is 30 to 50 percent of the values determined from core sampling data. The technical basis for the low uranium inventory estimate by the HDW model has not been identified.

C4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-A-102 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

The results from this evaluation support using the engineering evaluation as the best-basis for tank 241-A-102 for the following reasons.

1. The engineering evaluation uses sample results from two risers, one of which is an auger sample obtained in 1996 and the other is a core sample obtained in 1986. Limiting the inventory estimate to the 1996 auger sample only, also limits the data to a single riser.

2. Although the core sample was not documented to current quality control requirements, the 1986 samples were likely analyzed using good laboratory practice. Sample recovery of the core segments was 100 percent (Weiss and Schull 1988).

3. Sample recovery during the 1996 auger sampling event was average to poor.

4. The large number of waste types that are in the tank or were added to the tank and later removed is sufficiently complex that predicting tank inventories based on process flowsheets is impractical.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. 1997), all decayed to a common report date of January 1, 1994. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, etc., have been infrequently reported. For this reason it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. 1997, Section 6.1 and in Watrous and Wootan 1997.) Model generated values for radionuclides in any of 177 tanks are reported in the HDW Rev. 4 model results (Agnew et al. 1997). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result if available. (No attempt has been made to ratio or normalize model results for all 46 radionuclides when values for measured radionuclides disagree with the model.) For a discussion of typical error between model derived values and sample derived values, see Kupfer et al. 1997, Section 6.1.10.

Best-basis tables for chemicals and only four radionuclides (^{90}Sr, ^{137}Cs, Pu and U) were being generated in 1996, using values derived from an earlier version (Rev. 3) of the HDW model. When values for all 46 radionuclides became available in Rev 4 of the HDW model, they were merged with draft best-basis chemical inventory documents. Defined scope of work in fiscal year 1997 did not permit Rev. 3 chemical values to be updated to Rev. 4 chemical values.

Best-basis inventory estimates for tank 241-A-102 are presented in Tables C4-1 and C4-2. The projected inventory is primarily based on an engineering evaluation of the tank. The radionuclide inventories shown in Table C4-2 are based on the 1986 core sample results decayed to January 1, 1994, and Agnew et al. (1997) HDW model estimates. The inventory values reported in Tables D4-1 and D4-2 are subject to change. Refer to the Tank Characterization Database (TCD) for the most current inventory values.

Table C4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-A-102 (Effective February 14, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Al	7,045	S	
Bi	259	S	
Ca	410	S	
Cl	2,100	S	
TIC as CO_3	5,710	S	
Cr	1,880	S	
F	<73	S	
Fe	4,310	S	
Hg	0.115	M	
K	754	S	
La	27	S	
Mn	710	S	
Na	40,000	S	
Ni	120	S	
NO_2	21,900	S	
NO_3	34,000	S	
OH_{TOTAL}	25,110	C	Derived from charge balance
Pb	332	S	
P as PO_4	2,630	S	
Si	2,560	S	
S as SO_4	1,180	S	
Sr	16	S	
TOC	2,890	S	
U_{TOTAL}	5,830	S	

Table C4-1. Best-Basis Inventory Estimates for Nonradioactive Components in Tank 241-A-102 (Effective February 14, 1997). (2 Sheets)

Analyte	Total inventory (kg)	Basis (S, M, E, or C)[1]	Comment
Zr	241	S	

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based
C = Calculated by charge balance; includes oxides as hydroxides, not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table C4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-A-102 Decayed to January 1, 1994 (Effective February 14, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{3}H	32.9	M	
^{14}C	0.30	S	From 1986 core sample
^{59}Ni	7.17	M	
^{60}Co	87.0	S	From 1986 core sample
^{63}Ni	706	M	
^{79}Se	4.35	M	
^{90}Sr	135,000	S	From 1986 core sample
^{90}Y	135,000	S	Referenced to ^{90}Sr
^{93}Zr	19.1	M	
^{93m}Nb	16.0	M	
^{99}Tc	26.4	S	From 1986 core sample
^{106}Ru	0.0309	M	
^{113m}Cd	49.1	M	
^{125}Sb	30.0	M	
^{126}Sn	6.95	M	
^{129}I	<0.01	S	From 1986 core sample
^{134}Cs	0.681	M	
^{137}Cs	31,400	S	From 1986 core sample
^{137m}Ba	29,700	S	Referenced to ^{137}Cs
^{151}Sm	16,200	M	
^{152}Eu	4.28	M	
^{154}Eu	185	M	
^{155}Eu	262	M	
^{226}Ra	4.83 E-04	M	
^{227}Ac	0.00252	M	
^{228}Ra	0.0528	M	
^{231}Pa	0.00416	M	

Table C4-2. Best-Basis Inventory Estimates for Radioactive Components in Tank 241-A-102 Decayed to January 1, 1994 (Effective February 14, 1997). (2 Sheets)

Analyte	Total inventory (Ci)	Basis (S, M, or E)[1]	Comment
^{229}Th	0.00122	M	
^{232}Th	0.00572	M	
^{232}U	0.156	M	
^{233}U	0.597	M	
^{234}U	0.0950	M	
^{235}U	0.00376	M	
^{236}U	0.00308	M	
^{237}Np	0.135	M	
^{238}Pu	5.61	M	
^{238}U	0.133	M	
^{239}Pu	530	S	From 1986 core sample
^{240}Pu	28.1	M	
^{241}Am	315	S	From 1986 core sample. Growth from ^{241}Pu not available.
^{241}Pu	398	M	
^{242}Cm	0.159	M	
^{242}Pu	0.00234	M	
^{243}Am	0.00888	M	
^{243}Cm	0.0144	M	
^{244}Cm	0.519	M	

[1]S = Sample-based
M = Hanford Defined Waste model-based
E = Engineering assessment-based
NR = Not reported.

C5.0 APPENDIX C REFERENCES

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